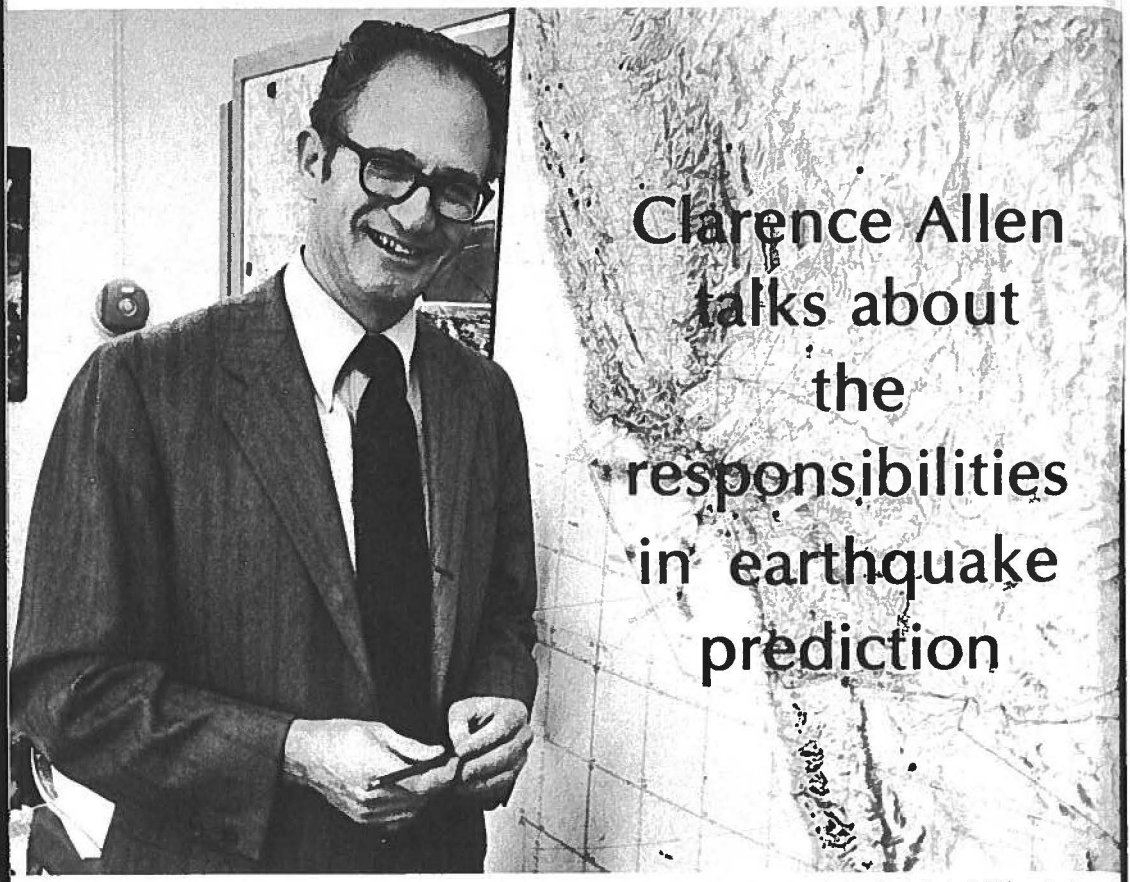

Clarence Allen talks about the responsibilities in earthquake prediction

Photographs by Floyd Clark, Calif. Inst. Tech.

" . . . as predictions are put forth, we have an overriding obligation to the public . . . . After all, lives, property, and public well-being are directly involved, whether we like it or not."

by Henry Spall,
U.S. Geological Survey,
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Dr. Clarence R. Allen is professor of geology and geophysics at the California Institute of Technology. He has been a member of advisory panels to the Executive Office of the President, National Academy of Sciences, National Science Foundation, U.S. Geological Survey, UNESCO, California State Mining and Geology Board, and the California Department of Water Resources. Dr. Allen has been President of both the Geological Society of America and the Seismological Society of America (SSA). The title of this interview is based on his presidential address to the SSA in 1976.

H.S.: Has the day of earthquake prediction arrived?

Allen: Very definitely. We're already at the stage where predictions are being offered and evaluated. Some successful predictions have already been made, although our batting average is still extremely low. My own opinion is that it's going to be at least 10 years before predictions can be made with sufficient reliability and consistency to be of great use to the public in this country.

H.S.: What constitutes a prediction?

Allen: No prediction should be considered valid, in my opinion, unless it specifies the time, the magnitude, and the place of occurrence—in writing, I might add. The point is that predictions must be made within sufficiently well-defined limits so that we can eventually

judge whether or not they have been successful.

H.S.: Should there be some kind of a confidence estimate attached to a prediction?

Allen: Yes, that's critical. During the early stages of developing our prediction program, some events will obviously be predicted with very high uncertainties. But we can't withhold this information just because the uncertainty is high. We must somehow get this concept of varying confidence levels across to the public if we are going to expect them to respond in rational ways. Actually, the author of a prediction is the only one who can make such an estimate. Certainly the public can't. It's an obligation that, in my opinion, lies clearly on the author's shoulders.

H.S.: How should the confidence estimate be stated?

Allen: Personally, I'd prefer a percentage probability of the kind that's now used in weather forecasts. It's something the public is already familiar with. I realize that the author of an earthquake prediction may not have a firm basis for assigning a probability (nor does the meteorologist, it often seems!). But there's a clear social obligation to make some sort of probability assignment—however it is expressed and however it is phrased.

H.S.: How does the public interpret "prediction?"

Allen: First of all, the word usually has a time connotation. The public is not accustomed to predictions that refer only to a *general area* in which an earthquake will occur at some unspecified time. People expect a time window (span of time) to be specified during which the event will happen.

Secondly, to the public, the word "prediction" implies a time window short enough so that some kind of temporary emergency response is called for, not long-term measures such as improved building codes or better land use planning. For instance, seismologists could talk about the possibility of an earthquake happening in the next 25 years, but from the public's point of view that would not be a real prediction. In my experience, the public thinks of predictions in terms of days and weeks, not years and decades.

H.S.: How can public officials decide whether a volunteered prediction is "valid" or not?

Allen: I think it's the responsibility of our scientific community to give guidance to public officials by setting up panels of experts to evaluate predictions. The State of California and the U.S. Geological Survey have already done so. Public officials are legally obligated to respond to warnings and predictions, from whatever source, and we must give them help. How are the city fathers of Pasadena, for example, to distinguish between a recognized scientific prediction and the ravings of a soothsayer? In all frankness, we must admit that the differences are sometimes not all that obvious, and, in any event, there are many shades of gray in between.

H.S.: Do scientists like working in the public eye?

Allen: Most of us are uncomfortable working in a fishbowl, with the public and the news media looking over our shoulders. But I do feel strongly that if we are going to claim that prediction research should be funded because it will be of eventual social benefit, then we must expect to work under public scrutiny. After all, they're the ones who are paying for it. And the social impact of a prediction, either a successful one or a false alarm, can be very, very great. It's quite unlike any other endeavor in the Earth sciences that we've worked on. Those who don't live in earthquake country perhaps can't appreciate the intensity of public interest in this subject.

H.S.: Does this mean that seismologists will have to be willing to deal more with the public?

Allen: There's no question about that. Unfortunately, public relations is an area in which most scientists are not very adept or comfortable. But I think that anyone working on prediction of specific events is obligated to interface with the public and the news media. Some of us have already been bloodied by these encounters, but this is part of the price we must pay for relevance to society's problems. I'm also convinced that the more we can aid the public in understanding a scientific phenomenon, the more constructive will be the public response, thus lessening the chances for panic and irrational reactions.

H.S.: One of the primary jobs of a scientist is to communicate his or her ideas to the scientific community. This is normally a slow, deliberate process involving a fair amount of protocol. Could earthquake prediction mean that a sci-

entist's first obligation now turns toward the public and the news media?

Allen: It would be indefensible for a scientist to withhold a significant earthquake prediction from public release solely because of problems with the scientific bureaucracy, such as publication delays in a scientific journal. Agreed, we're all working with our fellow scientists to develop our prediction capability, and, clearly, we have obligations within the scientific community. But as predictions are put forth, we have an overriding obligation to the public. They're the ones who will feel the direct impact of a prediction. After all, lives, property, and public well-being are directly involved, whether we like it or not.

H.S.: How confidential must scientists be? and how significant must their information be before anything is said about it?

Allen: This is a very difficult subject. One thing is very clear: The more we do behind closed doors, the more reason the public has to be suspicious of what we're doing. What is it we're trying to hide? What is it we're afraid might be revealed? We certainly have to make a deliberate effort to do as much as possible in the public domain and to make sure that there's no credibility gap between the scientific community and the public. Actually, with the climate of public awareness as it exists today, it would be impossible to keep an earthquake prediction confidential for very long, even if we wanted to. This applies both to academia and to the government. Of course, I am not implying that a proposed prediction should not be thoroughly and confidentially reviewed first by a scientist's own colleagues; internal review is certainly one of the procedures to assure ourselves that information is ready for wider exposure. But earthquake prediction represents a highly unusual situation because of the problem of "leaks." Even an unannounced seminar for colleagues has been known to cause rumors and subsequent inquiries from the news media. If one answers affirmatively to this sort of inquiry, then there will be literal inundation by the press within hours, if not minutes. If the answer is negative and this subsequently turns out to be somewhat less than honest, then relations with the news media will quickly deteriorate to the point of charges of a scientific credibility gap. I may seem to be overemphasizing this point about relations with the news media, but this is by no means a minor problem for those of us living in areas where rumors of a predicted earthquake can quickly drive even the most flamboyant of other news items out of the headlines. And I reiterate that the interest of the news media is a perfectly valid one in the light of our oft-repeated claim that earthquake prediction is really a significant endeavor in the public's direct interest.

H.S.: Earth scientists are not usually associated with having their thoughts scrutinized in public. What effect will this have?

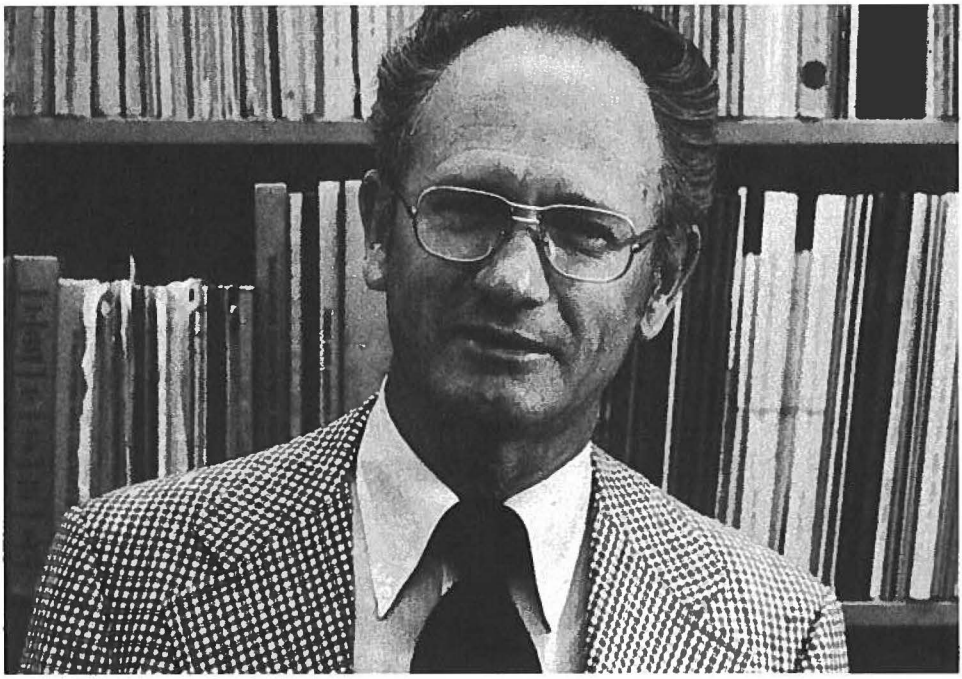
Allen: First, it will make scientists more cautious about issuing a prediction. But this is probably good; the potential impact is so great that we should be extremely cautious. Second, it may well dissuade some young scientists from going into this research field, which would be unfortunate. On the other hand, young people now are looking for careers that have relevance, that have significant social impact. In earthquake prediction, we can honestly say that we're working in a field that could have tremendous benefit for society. What could be more appealing to young people?

H.S.: Are there significant social benefits in earthquake prediction?

Allen: I think that the Chinese have admirably demonstrated that there are. The successful prediction of the 1975 Haicheng earthquake had a tremendous social impact—just look at the thousands of lives that probably were saved. Unfortunately, we don't know much about the social impact of their failures and false alarms. Admittedly, the structure of Chinese society is very different from that of ours, but I'm impressed that our sociological colleagues in this country seem to find that earthquake predictions could potentially be of great positive value here as well.

H.S.: Is it better to predict a destructive earthquake or to build structures that will withstand earthquakes?

Allen: Well, of course, no matter how accurate a prediction is, it's not going to stop the earthquake, and it's not going to prevent poorly constructed buildings from falling down. And there're lots of these in California and other earthquake-prone areas. No one should pretend that prediction is the sole solution to the earthquake-hazard problem, and we must make sure that we don't give the public or Congress this impression. Earthquake prediction is simply one



"The next 10 years are going to be rough ones for us .... But I'm convinced that we will eventually have an effective system for accurately and routinely predicting earthquakes."

of many hazard-reduction efforts that we should pursue. Certainly engineering for better construction is at least an equally important part of the effort. Other aspects include the removal or rehabilitation of older unsafe structures, as well as improved land use planning. I must say that I think some seismologists have gone a little too far in implying that prediction is *the* answer to the earthquake problem.

H.S.: How will the public react to false alarms and prediction failures? Is the public convinced that the scientific method is working for its benefit?

Allen: Initially it's going to be difficult to get people to accept the idea that the scientific method of observation-hypothesis-test is really working for their benefit. That's certainly the rationale we're going to be using after a failure or false alarm. It's exactly the same kind of trial and error that a scientist goes through in perfecting any new technique. This is an area where the Chinese have some major advantages; their social system can absorb failures and false alarms better than ours. It's really not at all clear how many major false alarms and failures the U.S. program could absorb and still maintain any kind of public support. We have some interesting, challenging, and probably frustrating times ahead!

H.S.: Are we really making scientific headway in earthquake prediction?

Allen: I think the answer is "yes," and I'm an optimist that we'll get there. But I reiterate that I think we're at least 10 years away from any kind of a routine and reliable prediction system. Of course, there's a wide spectrum of scientific opinion on this subject, and we've already had some disappointments; witness our excitement a few years ago about the use of velocity changes as a possible precursor. We must continue to ask ourselves hard questions. Will we have the courage to admit to ourselves and to our funding agencies if, after another few years of intensive effort, it turns out that our initial enthusiasm was unwarranted and that there really isn't much realistic hope of routinely predicting earthquakes within the foreseeable future? This is certainly a possible scenario.

Nevertheless, I personally remain optimistic. The next 10 years are going to be rough ones for us. We're going to stumble occasionally, and we're going to have to work hard to maintain continued public support. But I'm convinced that we will eventually have an effective system for accurately and routinely predicting earthquakes. And I'm also convinced that the results will be worth the effort.

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